CI C0011858

FAC – Lower Water Street Roof Replacement U&U

NON-CONFIDENTIAL

April 1, 2019

Nova Scotia POWER
An Emera Company

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An Emera Company

UARB APPROVAL SHEET

Project Title: FAC – Lower Water Street Roof Replacement U&U

CI Number: C0011858 **Date:** April 1, 2019

Expenditure Profile		
Year	Budget Amount	Project Estimate
2018		544,388
2019		1,128,209
Total	$0	$1,672,596

Type of Filing

- [X] Capital Project Authorization
  - [X] Unforeseen and Unbudgeted (U&U)
  - [ ] Planned & Advanced (P&A)
  - [ ] Subsequent Approval Item
- [ ] Authorization to Overspend (ATO)
- [ ] Scope Change
- [ ] Final Cost (FIN)

COMMENTS

Submitted on behalf of NOVA SCOTIA POWER INCORPORATED

Authorized Signatory
Mark Sidebottom
Chief Operating Officer

DATE 29th March 2019

Approved on behalf of NOVA SCOTIA UTILITY AND REVIEW BOARD

DATE

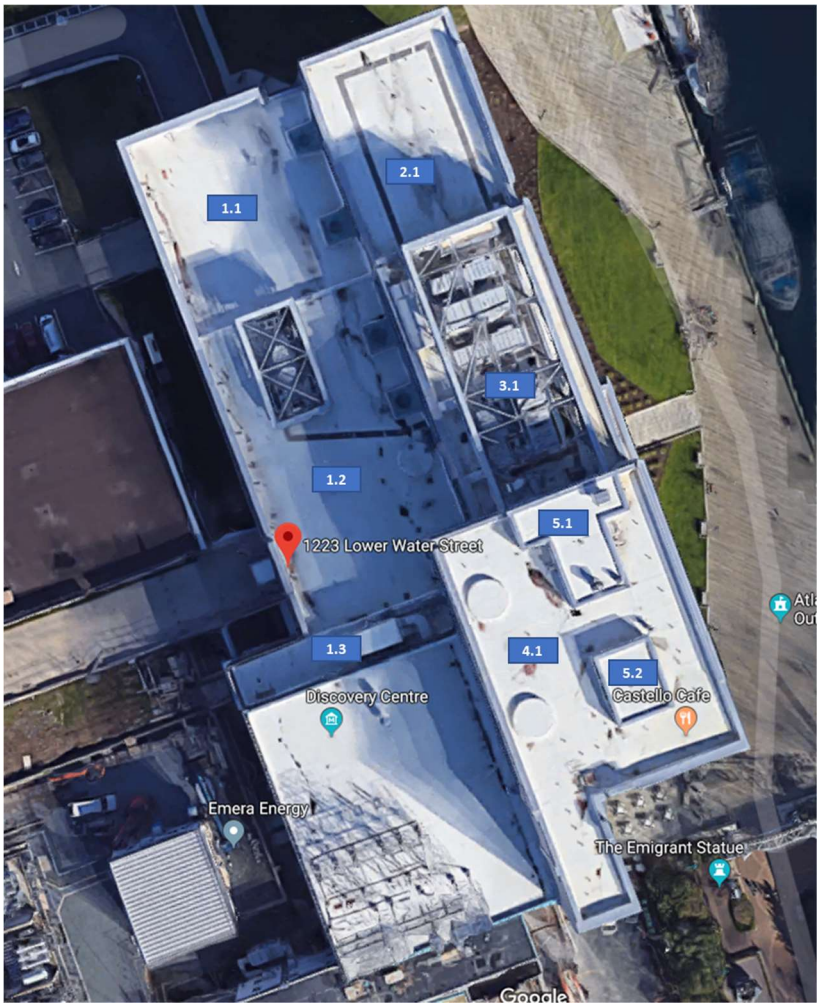
CI Number: C0011858

Title: FAC – Lower Water Street Roof Replacement U&U

Start Date:	2018/12
In-Service Date:	2019/07
Final Cost Date:	2020/01
Function Class:	General Plant
Amount:	$1,672,596

DESCRIPTION:

The scope of this project is the replacement of five roof sections at 1223 Lower Water Street due to severe delamination of the existing roof membrane. This project includes only those costs associated with the regulated portion of the Lower Water Street building (sections 1.1, 1.2, 1.3, 4.1 and 5.2 of the roof as illustrated in the diagram below).



Depreciation Class: General Plant – Structures and Improvements

Expected Life of the Asset: 25 years

JUSTIFICATION:

Justification Criteria: Work Support Facilities

Sub Criteria: Building Replacement/Modifications

Why do this project?

On January 3, 2018 during a high wind storm, sections of the Lower Water Street roof started to delaminate. Patio stones and sand bags were used to secure those sections of the roof to reduce further damage. Various repairs to delay further delaminating and stop leaking into the building have been ongoing. In April 2018, IRC Building Sciences Group (IRC) was contracted to to inspect the roof, determine the cause of the roof failure, prepare a detailed roof assessment report (please refer to Attachment 1) to document the existing condition of the roof and to make recommendations on repair or replacement options. IRC recommended replacement of all roof sections where wind damage was observed (sections 1.1, 1.2, 1.3, 4.1 and 5.2) within one year.

Why do this project now?

Based on the recommendations in IRC's roof condition assessment report, replacement of five roof sections needs to be completed now to avoid further water damage to the building and additional roof delaminatations. This project includes only those costs associated with the regulated portion of the Lower Water Street building (sections 1.1, 1.2, 1.3, 4.1 and 5.2 as shown in the diagram above)

Why do this project this way?

Based on the detailed roof assessment report prepared by IRC, repair of the five roof sections is not feasible and replacement is recommended.

CI Number : C0011858 - FAC – Lower Water Street Roof Replacement U&U **Project Number** C0011858

Parent CI Number : -

Asset Location : 1500 - 1500 General Plant General **Budget Version** UARB Submissions

Capital Item Accounts

Exp. Type	Utility Account	Forecast Amount
Additions	0300 - GP - Bldg.,Struct.Grnd.	1,569,239
Retirements	0300 - GP - Bldg.,Struct.Grnd.	103,357
	Total Cost:	1,672,596
	Original Cost:	981,347

Capital Project Detailed Estimate

Location: General Plant
CI# : C0011858
Title: FAC – Lower Water Street Roof Replacement U&U
Execution Year: 2018-2019

Description	Unit	Quantity	Unit Estimate	Total Estimate	Cost Support Reference	Completed Similar Projects (FP#'s)
Contracts						
Roofing Contractor - Flynn Canada Ltd.	Lot	1	$ 663,658	$ 663,658		
			Sub-Total	$ 663,658		
Consulting						
IRC Building Sciences Group	Lot	1	$ 57,000	$ 57,000		
			Sub-Total	$ 57,000		
Materials						
Materials	Lot	1	$ 591,250	$ 591,250		
			Sub-Total	$ 591,250		
Other Goods & Services						
Contingency	%	25%	$ 1,311,908	$ 327,977		
			Sub-Total	$ 327,977		
Interest Capitalized						
AFUDC				$ 32,711		
			Sub-Total	$ 32,711		
			SUB-TOTAL (no AO, AFUDC)	$ 1,639,885		
			TOTAL (AO, AFUDC included)	$ 1,672,596		
Original Cost				$ 981,347		

Note 1: The labour figures noted above are an average of salaries across a variety of jobs within similar classifications including fringe, and are used solely for budgeting purposes.
Note 2: Small differences in totals are attributable to rounding.

ROOF CONDITION ASSESSMENT REPORT

Prepared for:	**Owner** Nova Scotia Power Halifax, Nova Scotia
Attention:	Allison Donovan
Project:	**Nova Scotia Power Head Office** 1223 Lower Water Street Halifax, Nova Scotia
IRC Number:	IRC 20727
W.O. Number:	NR18-014CR
Report Date:	July 18, 2018
Consultants:	**IRC Building Sciences Group** 69 Maple Avenue New Glasgow, NS, B2H 2B3

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Appendix A Roof Plan

1 Introduction

1.1 Terms of Reference

IRC Building Sciences Group was authorized by Nova Scotia Power to conduct a site investigation and assessment of the roof assembly components at their head office situated at 1223 Lower Water Street in Halifax NS.

The objective of this analysis is to visually review the condition of the roof assembly and related components, to assess their existing condition and to make recommendations on future repair and/or replacement options.

1.2 Scope of Work

The scope of work includes the following elements and techniques:

.1 On-site visual review of all accessible roof areas. Visual record of all potential sites for water entry into the building. Interior visual walk through survey to ascertain location of leakage into the building.

.2 Interviews with appropriate building occupants and managers, in conjunction with document review, if available.

.3 Core-cut testing for the purposes of determining roof system configuration and composition.

.4 Moisture analysis of system components at core cut locations utilizing the Delmhorst Moisture Meter for the purpose of moisture verification at various locations:

i) Roof Interply System

ii) Insulation within the sub roof system.

.5 Preparation of a scale roof plan for reporting purposes.

1.3 Site Visit

The date of the roof assessment site visit was June 12th 2018 and the outside weather conditions during the visit were clear and sunny with a temperature of 18 degrees Celsius. The assessment team consisted of David MacDonald and Kevin Tulloch from IRC. Allison Donovan (Owner Representative) was on hand to provide information regarding roof leak history and locations.

1.4 Building Description and Roof Area Identification

For the purposes of this report, the front elevation of the building fronts along Lower Water Street in Halifax. (Photograph 1) The existing building is a multiple story steel frame and masonry commercial power generating station constructed in the early 1900's and substantially renovated with many of the old concrete walls replaced with glazed curtain walls, transforming it from a power generating station into office accommodations opening in 2012.

Nova Scotia Power owned the building when it operated as a power generating station and has occupied the space at this address since it was renovated. From our field review it is estimated that the roof systems are the original concrete deck with new roof assemblies built up above which are approximately 6 years old.

For the purposes of the reporting and data assembly, the roof area was divided into identifiable sections according to the boundaries set out by height changes.

1.5 Methodology/ Description of Investigation Techniques

Test Cuts and Moisture Probes - General

Core-cuts were made on the roof areas as part of the roof review to determine the composition of the roof system and the presence of moisture. The relative extent of moisture in the insulation layer was assessed using the Delmhorst Moisture Meter. This involves inserting metal probes that are attached to the moisture meter through into the insulation. The meter provides a reading that indicates whether or not moisture is present in the insulation layer. The detection of moisture indicates that the insulating qualities of the material may be impaired.

Test Cuts and Moisture Probes - Detailed

Test openings and membrane cut sampling were made on the roof areas as part of the roof review to confirm the composition of the roof system, condition of the waterproofing membrane and the presence of moisture. The *relative extent* of moisture under the membrane and within the insulation was assessed using the Delmhorst Moisture Meter. This involves inserting metal probes that are attached to the moisture meter through into the waterproofing membrane and thermal insulation substrate. The detection of moisture indicates that the insulating qualities of the material may be impaired.

The Delmhorst Moisture Meter utilizes a reference scale from 1 to 100 that indicates whether or not moisture is present in the materials. The term reference scale is used for a moisture meter reading mode wherein the meter takes qualitative readings as opposed to quantitative readings. These readings are shown as a numerical value which the user can then use to estimate whether that material is “wet” or “dry.”

It is important to note that the numbers used in a reference scale are not indicative of a specific percentage of moisture content. Instead, reading results in the reference scale are used as a relative indication of how much moisture a material has in it.

1.6 Maintenance History and Reported Leaks

Preventative maintenance on the existing roof systems has been relatively minimal and based on our visual review it appears that repairs have been primarily reactive and in response to leaks as they occur. Allison Donovan, Owner Rep noted that there had been an ongoing history of roof leaks throughout portions of the facility.

Leaks were reported or observed in locations as outlined in the table below:

Leak No.	Location/Area	Leak Details
1	**Roof Area 1.1**	Leak observed around north skylight on this roof area.
2	**Roof Area 1.2**	Leak observed around north skylight on this roof area.
3	**Roof Area 1.2**	Leak observed around south skylight on this roof area.
4	**Roof Area 3.1**	Pin holes and unsealed laps observed in north east section of this roof area.
5	**Roof Area 5.2**	Leak observed adjacent to windows below this roof level.

1.7 Limitations of the Study

IRC prepared this report solely for the client named. The responsibilities of IRC are as described in the Terms of Reference and the Scope of Work. The material in this report reflects the opinion of IRC at the time of preparation and within the terms of reference as agreed. Any use, which a Third Party makes of this report, or any reliance on decisions based on it, are the responsibility of such Third Parties.

IRC does not warrant the accuracy of the identified information provided by others at the time of the report preparation. Unless provided in writing, but not limited to, mistakes, contacts, insufficient information or certification of such information is not the responsibility of IRC.

Only the specific information or locations noted in the report have been reviewed. Although every reasonable effort was taken to identify defects, latent and hidden defects may affect the accuracy of this report. No physical or destructive testing and no design calculations have been performed unless indicated elsewhere in this report.

The assessment provided is based on visually observed defects at a limited number of locations and our experience with similar types of buildings. Deficiencies may exist at other areas not referenced in this report or that are not visually apparent given the level of evaluation. No responsibility is therefore assumed concerning these matters, or for failure to carry out technical or engineering techniques which would be required to discover any inherent or hidden conditions of the property since such an investigation was not included in the scope of work.

Report prepared by,

IRC Building Sciences Group

Anthony Travaglini
Project Manager

Michael Stewart
Maritimes District Manager

2 Roof Compositions

Roof Area	Estimated Age	Deck Type	Vapour Retarder	Insulation	Overlay Insulation	Membrane System	Surface	Perimeter Details	Approximate Thermal Resistance Above Deck (Insulation Dry)
1.1	6	Steel	Peel & Stick over 0.25" Recovery board	2 layers of 2.0" ISO	One layer of 0.5" recovery board	Fleece back Carlisle TPO single ply membrane	Single ply membrane	Parapet	-
1.2	6	Concrete	Peel & Stick	2 layers of 2.0" ISO	One layer of 0.5"recovery board	Fleece back Carlisle TPO single ply membrane	Single ply membrane	Parapet	-
1.3	6	Concrete	Peel & Stick	2 layers of 3.0" ISO	None	Fleece back Carlisle TPO single ply membrane	Single ply membrane	Parapet	-
2.1	6	Steel	Peel & Stick over 0.25 recovery board	2 layers of 2.0" ISO	One layer of 0.25" recovery board	Fleece back Carlisle TPO single ply membrane	Single ply membrane	Parapet	-
3.1	6	Concrete	Peel & Stick	2 layers of 2.0" ISO and 1 layer of 1" ISO	One layer of 0.25" recovery board	Fleece back Carlisle TPO single ply membrane	Single ply membrane	Parapet	-
4.1	6	Concrete	Peel & Stick over 4 Ply Built Up	2 layers of 2.0" ISO and Tapered ISO for crickets	One layer of 0.25" recovery board	Fleece back Carlisle TPO single ply membrane	Single ply membrane	Parapet	-
5.1	6	Concrete	Built Up	Multiple layers of 2.0" ISO	One layer of recovery board	Fleece back Carlisle TPO single ply membrane	Single ply membrane	Parapet	-
5.2	6	Concrete	Peel & stick over 4 ply Built Up	2 layers of 1.5" ISO	One layer of 0.25" recovery board	Fleece back Carlisle TPO single ply membrane	Single ply membrane	Parapet	-

3 Visual Survey

Photograph 1: Front elevation view of Nova Scotia Power Head Office

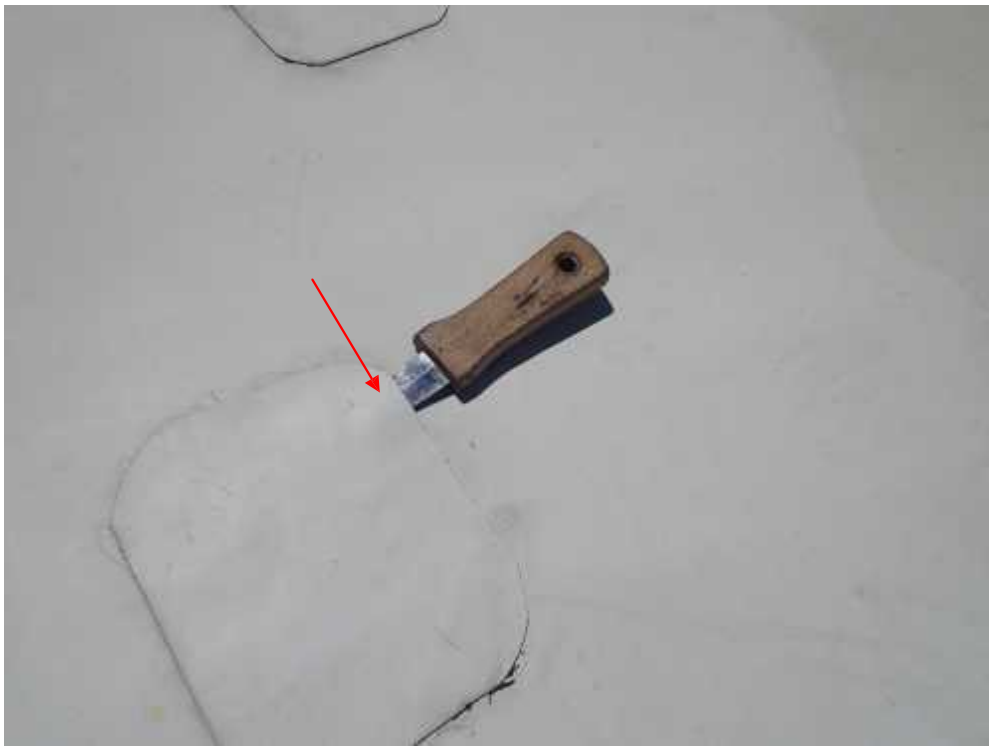
Photograph 2: Front Elevation of Nova Scotia Power Head Office.

Photograph 3: Roof Area 1.1 – areas of blow off are visible where patio pavers have been used as counter weights.

Photograph 4: Roof Area 1.1 – Skylight locations where reported leaks have been occurring.

Photograph 5: Roof Area 1.1 – Skylight does not appear to be secured down.

Photograph 6: Roof Area 1.1 – north east corner, wind uplift damage. Concrete masonry unit being used as weight. Also visible are mechanical fasteners holding membrane down to wall.



Photograph 7: Roof Area 1.1 – previous patch repairs that do not appear to have been heat welded entirely.

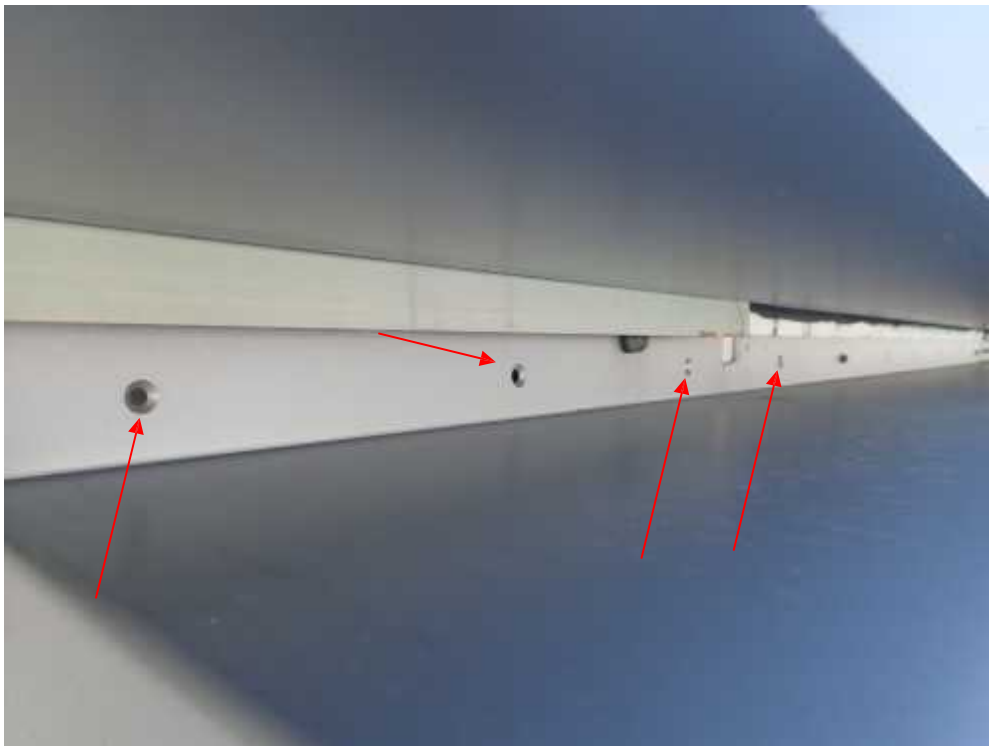
Photograph 8: Roof Area 1.1 – membrane seam not fully sealed around roof penetration duct work.

Photograph 9: Roof Area 1.1 – excessive standing water is evident due to build up around the roof drains on this roof area.

Photograph 10: Roof Area 1.1 – excessive standing water observed on this roof area.

Photograph 11: Roof Area 1.1 – metal support post does not have a securement strip around the post at the top of the TPO membrane termination.

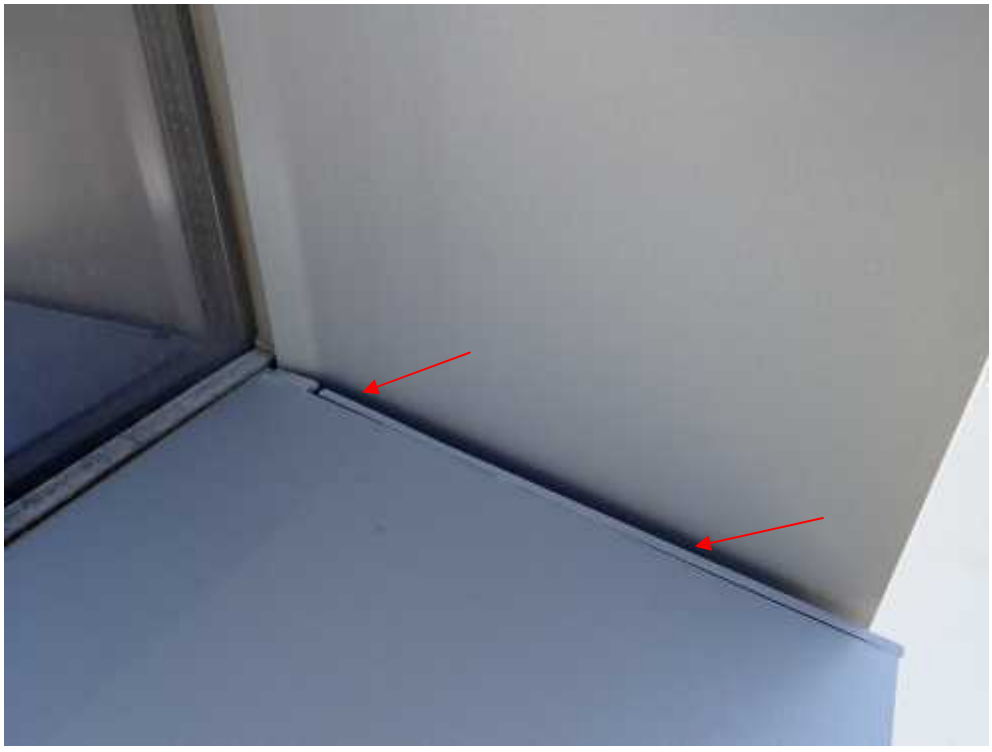
Photograph 12: Roof Area 1.1 – metal support post is missing the securement strip at the top of the post where the TPO membrane terminates.



Photograph 13: Roof Area 1.1 – skylight is missing multiple fasteners at the skylight-to-wall transition.

Photograph 14: Roof Area 1.1 – sealant separation between skylight frame members.

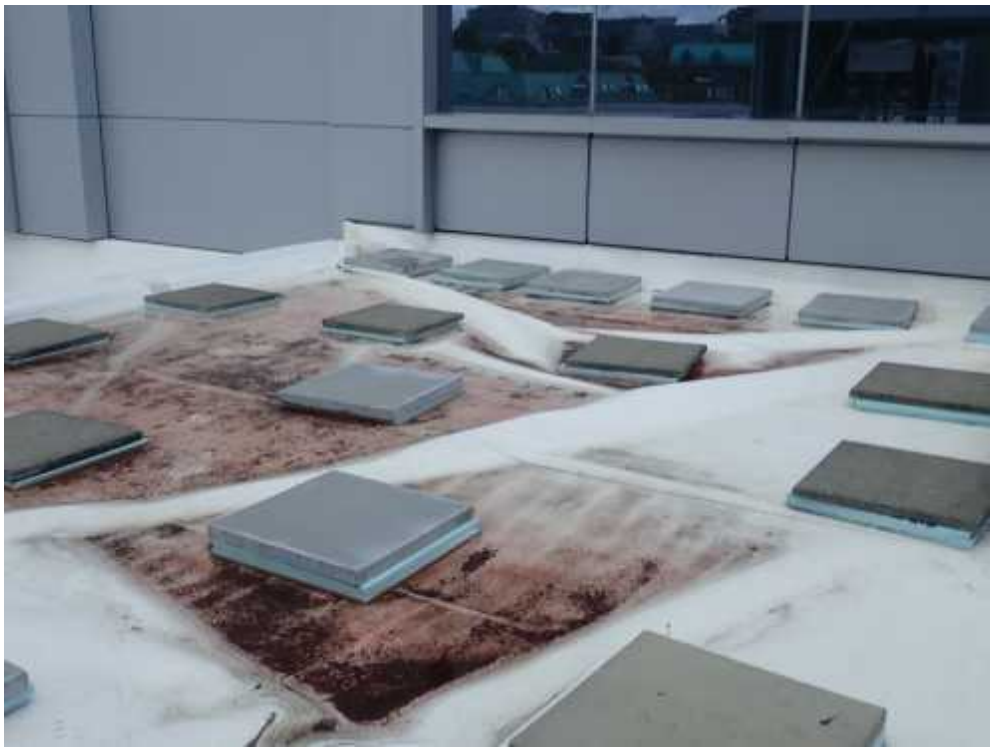
Photograph 15: Improperly secured flashing and pressure plates around the window frame.



Photograph 16: Roof Area 1.1 – separation at the window frame above roof membrane termination.

Photograph 17: Roof Area 1.2 – overall view looking north. Area with paving stones is visible where membrane has separated from roof assembly.

Photograph 18: Roof Area 1.2 – overall view looking north east. .



Photograph 19: Roof Area 1.2 – close up of north east section of roof where wind damage was observed. Overall area of wind damage is approximately 50'x70'.

Photograph 20: Roof Area 1.2 – close up of north east section of roof looking south where wind damage was observed.

Photograph 21: Roof Area 1.2 – ridging observed adjacent to the mechanical unit supports. Separation between membrane and underlayment board.

Photograph 22: Roof Area 1.2 – multiple repairs completed adjacent to the skylight assembly. Paving stones being used as a counter weight.

Photograph 23: Roof Area 1.2 – the seam is not fully sealed at this location at the perimeter wall.

Photograph 24: Roof Area 1.2 – membrane tenting has occurred at the base of curbs. Solid lines show membrane tenting, dotted lines show where membrane would be located to be considered fully adhered.

Photograph 25: Roof Area 1.2 – sealant separation at the pitch pocket at the base of the steel support legs.

Photograph 26: Roof Area 1.2 – No sealant observed at coolant and electrical penetrations into the mechanical curb.

Photograph 27: Roof Area 1.2 – Support bracket for skylight assembly does not bear on curb at all. Skylight assembly is not secured to curb.

Photograph 28: Roof Area 1.2 – large voids in the sealant joint surrounding the skylight assembly.

Photograph 29: Roof Area 1.2 – flashing/trim around the skylight assembly at the window-to-wall transition

Photograph 30: Roof Area 1.2 – Siding panels missing and poor termination of roofing membrane behind wall.

Photograph 31: Roof Area 1.3 – Overall view of roof area 1.3 facing east.

Photograph 32: Roof Area 1.3 – overall view of roof area 1.3 facing south west.

Photograph 33: Roof Area 1.3 – puncture observed in membrane at the curb adjacent to the mechanical unit.

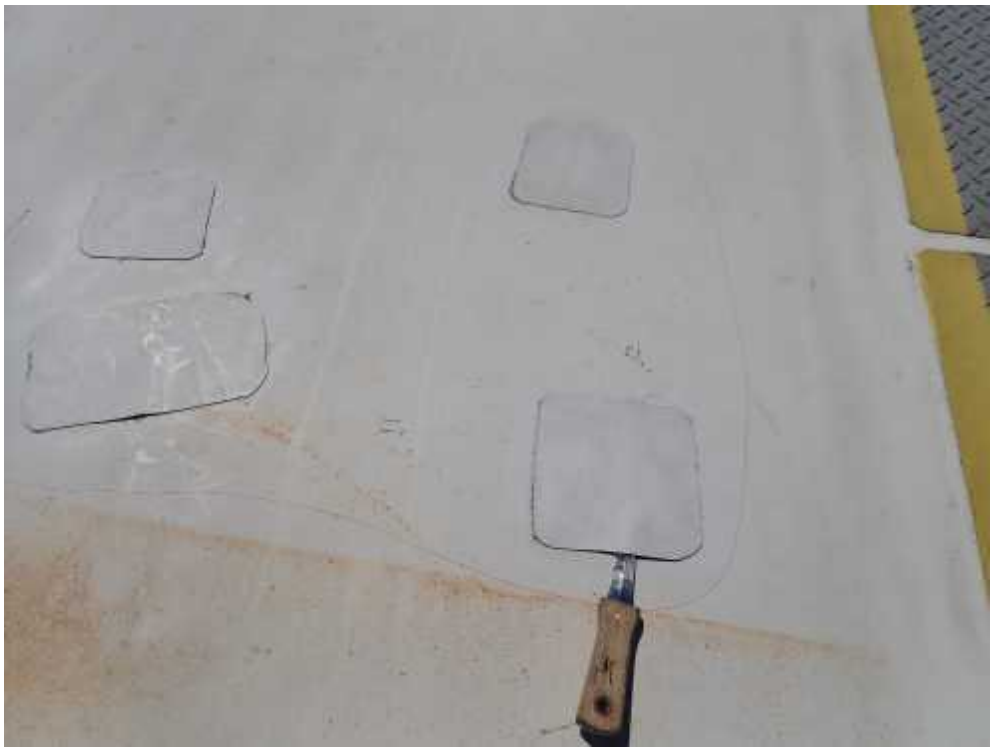
Photograph 34: Roof Area 1.3 – poor heat welding resulting in membrane separation at the field seams.

Photograph 35: Roof Area 1.3 – poor sealant and membrane termination at the support post base.

Photograph 36: Roof Area 1.3 – poor heat welding has resulted in seam failure.

Photograph 37: Roof Area 2.1 – overall of the roof area looking north

Photograph 38: Roof Area 2.1 – overall of the roof area looking south.



Photograph 39: Roof Area 2.1 – Poor heat welding at previous patch repairs. Membrane separation is evident.

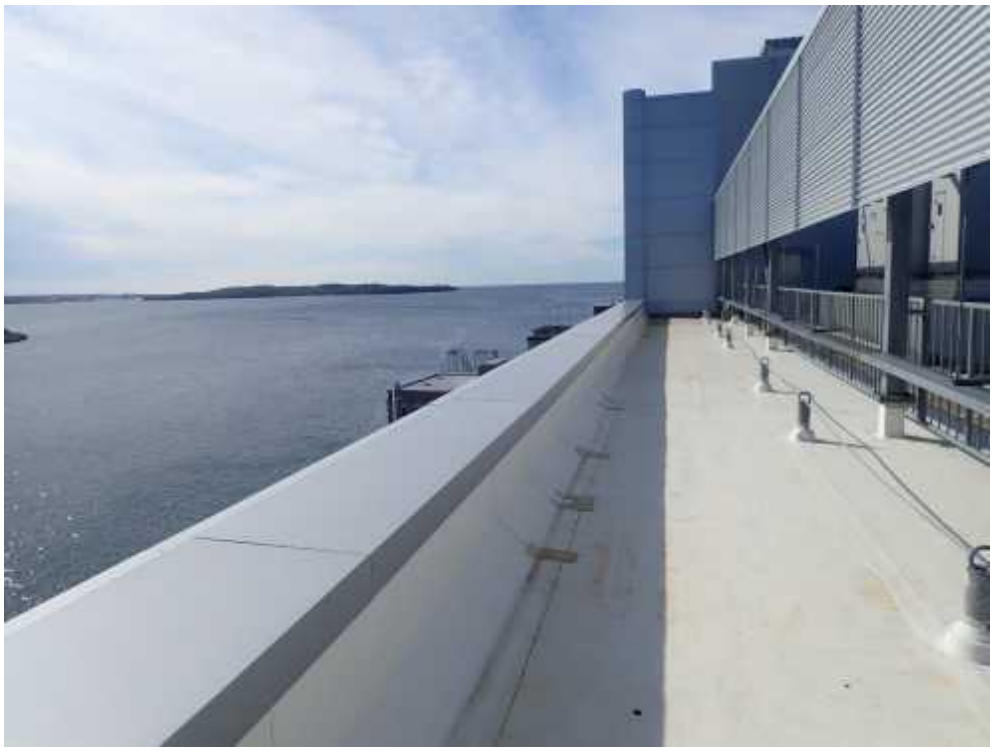
Photograph 40: Roof Area 2.1 – east wall – membrane separation at one location.

Photograph 41: Roof Area 2.1 – debris present around the drain. Ponding water is present due to slower drain times.

Photograph 42: Roof Area 2.1 – poorly secured counterflashing at the roof perimeter.

Photograph 43: Roof Area 2.1 – poorly secured counterflashing and loose counterflashing along the roof perimeter.

Photograph 44: Roof Area 3.1 – Partial view facing north



Photograph 45: Roof Area 3.1 – Partial view facing south.

Photograph 46: Roof Area 3.1 – east side of roof area – poorly welded seam. Membrane is not adhered fully.

Photograph 47: Roof Area 3.1 – membrane puncture on east side of roof.

Photograph 48: Roof Area 1.2 – the seam is not fully sealed at this location at the perimeter wall.

Photograph 49: Roof Area 3.1 – Debris present around the drain which slows the draining process. Water is present at this roof drain.

Photograph 50: Roof Area 3.1 – Poor sealant joint and no securement straps at the base of the support posts. Typical.

Photograph 51: Roof Area 3.1 – Loose flashings at the perimeter wall location.

Photograph 52: Roof Area 3.1 – improperly sealed membrane on the west side of roof area 3.1

Photograph 53: Roof Area 4.1 – Partial roof view facing north along the west half of the roof.

Photograph 54: Roof Area 4.1 – Partial view of the roof area facing west.

Photograph 55: Roof Area 4.1 – Previous wind damage observed. The membrane is fully separated from the underlayment board.

Photograph 56: Roof Area 4.1 - Previous wind damage observed. The membrane is fully separated from the underlayment board.

Photograph 57: Roof Area 4.1 – Membrane tenting at the roof perimeter has occurred.

Photograph 58: Roof Area 4.1 – Seam is not fully sealed.

Photograph 59: Roof Area 4.1 – Poor heat welding has resulted in separation of the seams at this location. .

Photograph 60: Roof Area 4.1 – Missing drain strainer adjacent to upturn wall of roof area 5.2.

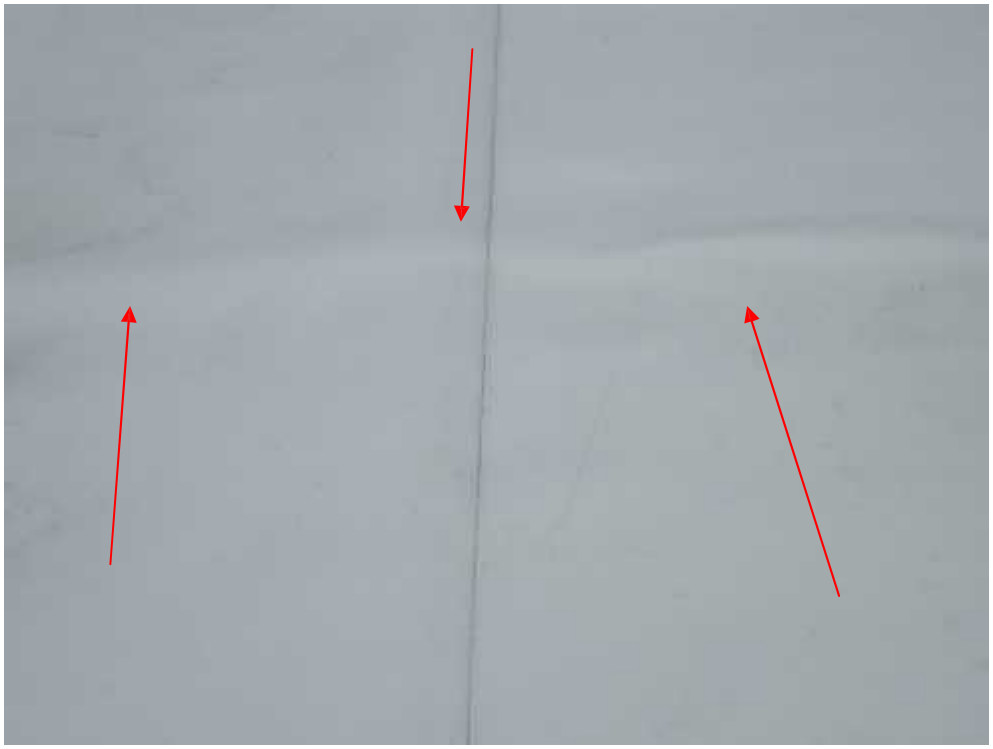
Photograph 61: Roof Area 4.1 – Cut test area number 1.

Photograph 62: Roof Area 4.1 – cut test location number 1, underlayment board contains excessive amounts of water.

Photograph 63: Roof Area 4.1 – Cut test location 1 – membrane adhesion to the underlayment board has failed.

Photograph 64: Roof Area 5.1 – Overall view of the roof area facing south

Photograph 65: Roof Area 5.1 – overall view of the roof area facing north. .



Photograph 66: Roof Area 5.1 – Membrane tenting in the field of the roof.

Photograph 67: Roof Area 5.1 – Membrane tenting at the perimeter of the roof.

Photograph 68: Roof Area 5.2 – Overall view of the roof area looking north west.

Photograph 69: Roof Area 5.2 – Overall view of the roof area looking south.

Photograph 70: Roof Area 5.2 – Multiple ridges and tenting visible, membrane is not adhered to the underlayment board.

Photograph 71: Roof Area 5.2 – Membrane tenting at the perimeter of the roof.

Photograph 72: Roof Area 5.2 – Membrane tenting in the field of the roof.

Photograph 73: Wall area below roof area 5.2 – large gaps at window head.

4 Summary of Observations

4.1 TPO Roof Systems – System Description

TPO Roof Membranes

TPO (Thermoplastic polyolefin) is a compound of ethylene and propylene, which is used as an elastomeric single-ply roofing membrane. TPO roofing membranes are a newer product than the more commonly used ethylene propylene diene monomer (EPDM), and are heat-weldable like polyvinyl chloride (PVC). TPOs do not contain plasticizers and so avoid the problem of plasticizer loss. However, little is known about their durability characteristics such as tensile breaking strength or elongation at break, which govern how the material will respond to physical forces such as impact or abrasion. As with other single ply systems, the membrane can be susceptible to damage by heavy impact or point loading. The membrane is a popular choice for "Green" buildings. It is widely available in white and by using white roof material it helps reduce the "heat island effect" and solar heat gain in the building.

TPO roofing membrane is typically installed using mechanical fasteners and plates placed along the edge of the sheet and fastened through the membrane and into the roof decking. Adjoining sheets of TPO membrane are overlapped, covering the fasteners and plates, and joined together with a minimum 40 mm (1 1/2 in.) wide hot air weld.

One of the primary benefits of TPO membrane is the ability to fuse the sheets together with a hot air weld. The welding process results in a bond that is actually stronger than the sheet itself. Flashing details, such as exhaust vents, pipes and parapet corners are also completed using hot air welds and flashing material.

4.1.1 Roof Area 1.1

This roof area (Photograph 3 and 4) is located at the north east corner of the building and consists of a mechanically fastened TPO membrane system which is approximately 6 years old. The existing roof was completed in 2012 and consists of a steel roof deck, a peel and stick (over recovery board) vapour barrier, 2 layers of 2.” poly iso insulation, one layer of 0.5” recovery board (All adhered in place) with a fleece back Carlisle TPO single ply membrane also adhered to the existing recovery board using foamable adhesive.

1. There are reoccurring roof leaks at the north east corner of this roof section and around the existing skylights. The skylights do not appear to be secured to the curb with any observed fasteners. (Photograph 5).
2. The existing membrane has suffered wind damage in the north east corner in a previous wind storm. Repairs using mechanical fasteners and cover strips have been completed, however excessive tenting/membrane separation is evident around the perimeter where the blow off occurred. (Photograph 6).
3. Minor membrane de bonding is also evident on the field in various areas, possibly caused by water infiltration saturating the recovery board. Previous repairs were observed (Photograph 7).
4. All field seams checked were sealed to acceptable standards.
5. The fully bonded TPO membrane around the top of the perimeter wall on the north end is also showing signs of membrane separating from the wall substrate causing tenting to occur.
6. There are multiple areas around the curbs and perimeter wall where the membrane seams were not fully sealed. (Photograph 8)
7. Multiple membrane patches on the field where also improperly sealed. (Photograph 7).
8. Excessive standing water is evident due to debris build up around the roof drains. (Photograph 9 and 10)
9. The metal support posts are missing the securement strips around the top of the TPO membrane. (Photograph 11 and 12)
10. The existing skylights are improperly secured to the curb allowing excessive movement to occur. Sealant separation is evident around the existing skylight frames in multiple areas. Multiple metal fasteners are missing around the flashing leaving them improperly secured. (Photograph 13 and 14)
11. The window trim on the wall is also improperly secured, causing separation between the windows and flashing in multiple areas. This is allowing water to run in behind the sky lights in various areas. (Photograph 15 and 16)

4.1.2 Roof Area 1.2

This roof area (Photograph 17 and 18) is located at the west half of the building and consists of a mechanically fastened TPO membrane system which is approximately 6 years old. The existing roof was completed in 2012 and consists of a concrete roof deck, peel & stick vapour barrier, 2 layers of 2.” poly iso insulation, one layer of 0.5” recovery board (All adhered in place) with a fleece back Carlisle TPO single ply membrane also adhered to the existing recovery board using foamable adhesive.

1. The existing membrane has suffered significant wind damage in a previous wind storm. The membrane has fully separated from the recovery board on an area of approximately 50’x70’. (Photograph 19 and 20).
2. Ridging has occurred on the field in multiple areas indicating the membrane has begun to separate from the recovery board. (Photograph 21).
3. Multiple repairs have been completed in various areas, however water infiltration is evident on the east side where the blow off has occurred and around the skylights. (Photograph 22)
4. There are multiple areas where minor membrane separation has occurred on the field seams.
5. There are areas around the curbs and perimeter wall where the membrane seams were not fully sealed. (Photograph 23)

6. Membrane tenting has occurred around the curbs in various areas. (Photograph 24).
7. A minor amount of standing water is evident due to debris build up around the roof drains.
8. The metal support posts are missing the securement strips around the top of the TPO membrane.
9. Multiple pitch pockets are showing signs of sealant separation. (Photograph 25).
10. One pipe box is also improperly sealed where the piping runs in to the curb. (Photograph 26).
11. The existing skylights are improperly secured to the curb allowing excessive movement to occur. Sealant separation is evident around the existing skylight frames in multiple areas. Multiple metal fasteners are missing around the flashing leaving them improperly secured. (Photograph 27 and 28).
12. The window trim on the wall is also improperly secured, causing separation between the windows and flashing in multiple areas. This is allowing water to run in behind the sky lights in various areas. (Photograph 29).
13. There are also multiple siding panels that are improperly secured in place on the east wall. (Photograph 30)

4.1.3 Roof Area 1.3

This roof area (Photograph 31 and 32) is located at the south west corner of the building and consists of a mechanically fastened TPO membrane system which is approximately 6 years old. The existing roof was completed in 2012 and consists of a concrete roof deck, peel & stick vapour barrier, 2 layers of 3.” poly iso insulation, no recovery board (All adhered in place) with a fleece back Carlisle TPO single ply membrane also adhered to the existing recovery board using foamable adhesive.

1. The existing membrane is in fair condition and is adhered to the recovery board.
2. Multiple repairs have been completed in various areas and there are no reported leak areas. One membrane puncture was discovered during the review, on the existing roof curb. (Photograph 33).
3. There are areas where minor membrane separation has occurred on the field seams and around the support posts. (Photograph 34).
4. There are areas around the curbs and perimeter wall where the membrane seams were not fully sealed. Two metal support posts are missing the securement strips around the top of the TPO membrane. (Photograph 35 and 36).
5. Minor membrane tenting has occurred around the curbs in various areas.
6. At the south wall roof to wall transition, the tie ins appear to be improperly installed. No base of wall flashing was observed to terminate the metal siding. The sealant joint appears to be the only interface between the metal and the TPO membrane.

4.1.4 Roof Area 2.1

This roof area (Photograph 37 and 38) is located at the north east corner of the building and consists of a mechanically fastened TPO membrane system which is approximately 6 years old. The existing roof was completed in 2012 and consists of a steel roof deck, peel & stick vapour barrier (over recovery board), 2 layers of 2.” poly iso insulation, one layer of 0.25” recovery board (All adhered in place) with a fleece back Carlisle TPO single ply membrane also adhered to the existing recovery board using foamable adhesive.

1. The existing membrane is in fair condition and is adhered to the recovery board.
2. Multiple repairs have been completed in various areas and there are no reported leak areas.
3. There are areas where membrane separation has occurred around multiple membrane patches. (Photograph 39).
4. Improperly sealed membrane is also evident on the East wall in multiple locations. (Photograph 40).
5. Minor membrane tenting has occurred around the lower perimeter walls in various areas.

6. Debris is evident around the existing roof drain slowing the drainage process. (Photograph 41).

4.1.5 Roof Area 3.1

This roof area (Photograph 44 and 45) is located at the east half of the building and consists of a mechanically fastened TPO membrane system which is approximately 6 years old. The existing roof was completed in 2012 and consists of a concrete roof deck, peel & stick vapour barrier, 2 layers of 2"and 1 layer of 1" poly iso insulation, one layer of 0.25" recovery board (All adhered in place) with a fleece back Carlisle TPO single ply membrane also adhered to the existing recovery board using foamable adhesive.

1. The existing membrane is in fair condition and is adhered to the recovery board.
2. Multiple repairs have been completed in various areas; however there is one reoccurring roof leak on the east wall.
3. There are areas where membrane separation has occurred between multiple field seams and membrane patches along the east wall. (Photograph 46).
4. One membrane puncture was discovered on field of the east side. Membrane tenting has occurred around the base of multiple curbs in various areas. There are also multiple backward laps around various curbs. (Photograph 47).
5. Excessive tenting is evident on the North wall by the access door. (Photograph 48).
6. Debris is evident around the existing roof drain slowing the drainage process. (Photograph 49).
7. Missing securement straps are evident around the support post in multiple locations. (Photograph 50).
8. Missing metal flashings are evident on the west side in one area. Improperly sealed membrane is also evident in this location. Improperly secured metal flashings are also evident in various areas around the perimeter walls. (Photograph 51 and 52).
9. The existing gas lines are showing signs of surface corrosion in multiple locations.

4.1.6 Roof Area 4.1

This roof area (Photograph 53 and 54) is located at the south half of the building and consists of a mechanically fastened TPO membrane system which is approximately 6 years old. The existing roof was completed in 2012 and consists of a concrete roof deck, 4 ply built up roof, peel & stick vapour barrier, 2 layers of 2." poly iso insulation, one layer of 0.25" recovery board (All adhered in place) with a fleece back Carlisle TPO single ply membrane also adhered to the existing recovery board using foamable adhesive.

1. The existing membrane has suffered significant wind damage in a previous wind storm and is now fully separated from the recovery board on approximately 1/2 of the roof. Pavers have been installed to hold the existing membrane in place until repairs/replacement is completed. (Photograph 55 and 56).
2. The fully bonded TPO membrane around the curbs and perimeter walls has also fully separated in multiple areas causing excessive membrane tenting to occur. (Photograph 57).
3. Excessive membrane tenting is also evident on the field of the roof in multiple areas.
4. There are multiple locations where the TPO membrane seams are not fully sealed on the field and at up turn/detail locations, due to inconsistent heat welding/ patching. (Photograph 58 and 59).
5. One existing drain strainer is missing or out of place. (Photograph 60).

6. Cut test revealed excessive moisture on the walls and on the field in multiple areas. The moisture has fully saturated the underlayment board causing membrane failure. (Photograph 61 and 62).
7. It is believed that moisture got below the membrane, causing the Dense Deck underlayment board to become saturated with water. This has caused membrane separation between the adhesive holding the TPO in place and recovery board. Due to high winds the membrane is now fully separated and requires immediate replacement. (Photograph 63).

4.1.7 Roof Area 5.1

This roof area (Photograph 64 and 65) is located at the south west corner of the building and consists of a mechanically fastened TPO membrane system which is approximately 6 years old. The existing roof was completed in 2012 and consists of a concrete roof deck, a vapour barrier installed over a 4-ply built up roof, multiple layers of 2.” poly iso insulation, one layer of recovery board (All adhered in place) with a fleece back Carlisle TPO single ply membrane also adhered to the existing recovery board using foamable adhesive.

1. The existing membrane is in fair condition and is adhered to the underlayment board except where noted.
2. Multiple repairs have been completed in various areas and there are no reported leak areas.
3. Ridging is evident in multiple areas on the field of the roof. (Photograph 66).
4. Minor membrane tenting has occurred around the perimeter walls in various areas. (Photograph 67).
5. All membrane seams checked were sealed to acceptable standards.

4.1.8 Roof Area 5.2

This roof area (Photograph 68 and 69) is located at the south west corner of the building and consists of a mechanically fastened TPO membrane system which is approximately 6 years old. The existing roof was completed in 2012 and consists of a concrete roof deck, 4-ply built up roof, peel & stick vapour barrier, 2 layers of 1.5.” poly iso insulation, one layer of 0.25” recovery board (All adhered in place) with a fleece back Carlisle TPO single ply membrane also adhered to the existing recovery board using foamable adhesive.

1. The existing membrane has suffered significant wind damage in a previous wind storm and is now fully separated from the recovery board on the entire roof area. (Photograph 70).
2. The fully bonded TPO membrane around the perimeter walls have also fully separated causing excessive membrane tenting/separation to occur. (Photograph 71).
3. There are multiple locations where the TPO membrane seams are improperly sealed on the field and around the detail, due to inconsistent heat welding/ patching. (Photograph 72).
4. It is believed that moisture got below the membrane, causing the Dens Deck recovery board to become saturated with water. This has caused membrane separation between the adhesive holding the TPO in place and recovery board. Due to high winds the membrane is now fully separated and requires immediate replacement.
5. Improperly installed windows are also evident on the penthouse wall which may also be allowing water infiltration to occur. (Photograph 73). Large gaps at the window head were observed. The window sill has an unknown membrane installed. The interaction of this membrane with the TPO roofing membrane is unknown. Interior damage was observed indicating water infiltration. The installation of this unknown membrane is also unknown. Further investigation at these windows is recommended.

5 Recommendations

5.1 Replacement Recommendations

1. Replace all roofs where wind damage was observed. The extent of saturated insulation is unknown. Further investigation on the insulation is recommended prior to replacement.
2. Roof areas requiring replacement; 1.1, 1.2, 1.3, 4.1 and 5.2. This work should be carried out within the next 0-1 years.
3. Implement a new 2-ply roof system to better withstand freeze-thaw cycles. The existing 1-ply TPO roofing system is not adequate for Atlantic Canada's climate.

5.2 Maintenance Recommendations

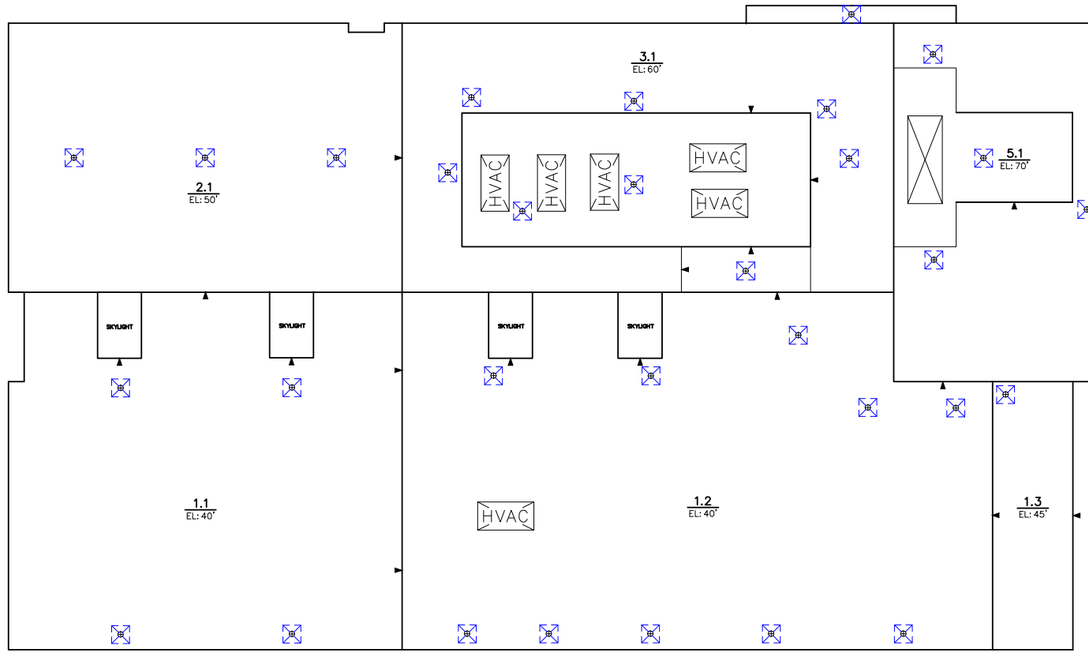
1. Maintenance repairs are required on the following roof areas; 5.1, 2.1 and 3.1.
2. Remove all debris from roof surface and from around drain openings and perimeter parapets. Localized membrane cleaning (with mild detergent) and power washing at drain locations is recommended.
3. Repair membrane wrinkling that is impacting seams.
4. Repair membrane damage and punctures.
5. Repair protruding seam and insulation fasteners. Replace fasteners and repair membrane as required.
6. Secure gas line supports.
7. Seal rain collars and install clamps at electrical boot flashings (where missing).
8. Install membrane "T"-patches where required.
9. Install proper TPO boot flashings at mechanical piping penetrations.
10. Install membrane protection at the roof access hatch, access ladder, and gas line supports.
11. Perform thermographic scan to detect any moisture within the assembly.
12. Perform annual reviews to monitor roof performance.

5.3 Active Construction Work Impacting Roof Systems

Service life expectancies and opinions regarding current roof conditions within this report are based on the assumption that the roofs will receive the recommended maintenance and repairs and will not be impacted by future re-development or major alteration work. If major work is contemplated that impacts the roof system, a re-assessment would be required to determine if the roof should be replaced in conjunction with the re-development project.

Appendix A

Roof Plan



ROOF AREAS (SQ. FT.)

1.1 – 6,688
1.2 – 9,822
1.3 – 1,086
2.1 – 5,282
3.1 – 6,808
4.1 – 8,116
5.1 – 1,080
5.2 – 520

TOTAL = 39,402

LEGEND

ROOF OPENING

ROOF PROJECTIONS:

ANTENNA	HVAC UNIT ON SLEEPERS
BREATHER	LADDER
CAPPED OFF/ ABANDONED STACK	LIGHT POST
CHANGE IN ELEV.	PIPE SUPPORT
CHIMNEY	PITCH POCKET
CONDUIT LINE	PLUMBING OR SOIL STACK
CONTROL JOINT	ROOF ANCHOR
DRAIN	SATELLITE DISH
EXHAUST FAN ON CURB	SCUPPER
EXPANSION JOINT	SECURITY CAMERA
EXPLOSION HATCH	SKYLIGHT
FLAGPOLE	SLOPE
GAS PIPELINE	SQUARE VENT
GOOSENECK VENT	SQUARE VENT ON OVERSIZED CURB
GOOSENECK VENT ON OVERSIZED CURB	TALLCONE OR "B" VENT
HATCH	TALLCONE OR "B" VENT ON CURB
HVAC UNIT	UNUSED OPENING
HVAC UNIT ON CURB	WALKWAY PADS

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TITLE:	ROOF PLAN
CLIENT:	NOVA SCOTIA POWER
PROJECT:	NOVA SCOTIA POWER LIMITED CORPORATE OFFICE FACILITIES LOWER WATER STREET, HALIFAX, NS
IRC #:	20727
W.O.#:	NR18-015SP
SCALE:	1/32"=1'-0"
DATE:	12 JULY 2018
DRN. BY:	V.A.
CHK. BY:	A.T.

PROJECT NORTH: N (TRUE NORTH)

DWG.#: R1

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